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A method of producing elastomer masterbatch, comprising:

feeding a continuous flow of first fluid comprising elastomer latex to a mixing zone of a coagulum reactor defining an elongate coagulum zone extending from the mixing zone to a discharge end;

feeding a continuous flow of second fluid comprising particulate filler under pressure to the mixing zone of the coagulum reactor to form a mixture with the elastomer latex, the mixture passing as a continuous flow to the discharge end and the particulate filler being effective to coagulate the elastomer latex, wherein mixing of the first fluid and the second fluid within the mixing zone is sufficiently energetic to substantially completely coagulate the elastomer latex with the particulate filler prior to the discharge end; and

discharging a substantially continuous flow of elastomer masterbatch from the discharge end of the coagulum reactor.

- 2. The method of producing elastomer masterbatch in accordance with claim 1 wherein the second fluid is fed to the mixing zone through a nozzle at a velocity of 100 to 600 feet per second.
- 3. The method of producing elastomer masterbatch in accordance with claim 2 wherein the first fluid is fed continuously into the mixing zone at a velocity lower than 12 feet per second.
- 1 4. The method of producing elastomer masterbatch in accordance with claim 1 wherein 2 the elastomer latex is natural rubber latex and the particulate filler is carbon black.

- 5. The method of producing elastomer masterbatch in accordance with claim 1 further comprising feeding an auxiliary fluid to the mixing zone, the auxiliary fluid being substantially non-reactive with the mixture.
- 1 6. The method of producing elastomer masterbatch in accordance with claim 5 wherein 2 the auxiliary fluid is air.
- The method of producing elastomer masterbatch in accordance with claim 1 wherein
 the coagulum zone has progressively increasing cross-sectional area.
 - A continuous flow method of preparing elastomer masterbatch of particulate filler dispersed in elastomer, comprising:
 - A) establishing a continuous, semi-confined flow of mixed elastomer latex and particulate filler under pressure in a coagulum reactor forming an elongate coagulum zone extending with progressively increasing cross-sectional area from an entry end to a discharge end, by simultaneously
 - (i) feeding elastomer/latex fluid continuously to a mixing zone at the entry end of the coagulum reactor, and
 - (ii) entraining the elastomer latex fluid into particulate filler fluid by feeding the particulate filler fluid as a continuous jet into the mixing zone; and
 - B) discharging from the discharge end of the coagulum reactor a substantially constant flow of elastomer masterbatch globules concurrently with feeding of the fluid streams in accordance with steps A(i) and A(ii).

- 9. The continuous flow method of producing elastomer masterbatch in accordance with claim 8 wherein coagulation of the elastomer latex is substantially complete in the elastomer masterbatch globules as they are discharged from the discharge end of the coagulum reactor.
- 1 10. The continuous flow method of producing elastomer masterbatch in accordance with claim 8 further comprising the step of preparing the particulate filler fluid by high energy dispersion of the particulate filler in a liquid in a homogenizer having an outlet port in fluid communication with the mixing zone.
- 1 11. The continuous flow method of producing elastomer masterbatch in accordance with claim 8 wherein the liquid slurry is fed into the mixing zone through a nozzle at a velocity of 100 to 600 feet per second.
- 1 12. The continuous flow method of producing elastomer masterbatch in accordance with claim 11 wherein the velocity of the liquid slurry through the nozzle is from 200 to 500 feet per second.
- 1 13. The continuous flow method of producing elastomer masterbatch in accordance with claim 8 further comprising the step of premixing minor amounts of additives into the elastomer latex prior to feeding the elastomer latex to the mixing zone.
- 1 14. The continuous flow method of producing elastomer masterbatch in accordance with claim 8 wherein the particulate filler fluid is an aqueous carbon black dispersion.

- 1 15. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 8 wherein the particulate filler fluid comprises particulate filler selected from the
- group consisting of silicon treated carbon black, fumed silica, precipitated silica, and
- 4 mixtures of any of them.
- 1 16. The continuous flow method of preparing elastomer masterbatch in accordance with
- 2 claim 8 wherein the elastomer latex fluid consists essentially of natural rubber latex.
- 1 17. The continuous flow method of preparing elastomer masterbatch in accordance with
- 2 claim 16 wherein the natural rubber latex is natural rubber latex concentrate.
- 1 18. The continuous flow method of preparing elastomer masterbatch in accordance with
- 2 claim 16 wherein the natural rubber latex is field latex.
- 1 19. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 8 further comprising mixing additive to the semi-confined flow by separately feeding
- an additive fluid continuously to the mixing zone simultaneously with the elastomer latex
- 4 fluid and the particulate filler fluid.
- 1 20. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 8 wherein the additive is selected from antiozonants, antioxidants, plasticizers,
- 3 processing aids, resins, flame retardants, extender oils, lubricants, and mixtures of any of
- 4 them.

- 1 21. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 8 further comprising injecting pressurized gas into the mixing zone.
- 1 22. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 21 wherein the pressurized gas is injected separately into the mixing zone.
- 1 23. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 22 wherein the pressurized gas is injected into the mixing zone through a nozzle
- 3 together with the particulate filler fluid.
- 1 24. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 8 wherein step A(ii) comprises feeding multiple streams of particulate filler fluid to
- 3 the mixing zone continuously through multiple nozzles.
- 1 25. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 8 further comprising, simultaneously with steps A(i) and A(ii), feeding at least one
- 3 auxiliary stream of elastomer latex fluid to the mixing zone.
- 1 26. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 8 further comprising the step of drying the elastomer masterbatch globules received
- from the discharge end of the coagulum reactor, through a series of multiple dryers.
- 1 27. The continuous flow method of producing elastomer masterbatch in accordance with
- 2 claim 26 further comprising the step of baling the elastomer masterbatch by sequentially
- 3 compressing 25 to 75 pound quantities of the elastomer masterbatch after the drying step.

1	28.	The continuous flow method of producing elastomer masterbatch in accordance with	
2	claim 8 wherein the elastomer latex fluid is fed under pressure less than 10 psig and the		
particulate filler fluid is fed under pressure of at least 75 psig.			
1	29.	A continuous flow method of producing rubber masterbatch by coagulating natural	
2	rubber latex with carbon black, comprising:		
3		A) establishing a continuous, semi-confined flow of mixed natural rubber latex	
4		and carbon black in a coagulum reactor forming a generally tubular coagulum zone	
5	extending with progressively increasing cross-sectional area from an entry end t		
6		an open discharge end, by simultaneously	
7		(i) feeding a liquid stream of the natural rubber latex continuously to	
8		a mixing zone at the entry end of the coagulum reactor, and	
9		(ii) entraining the natural rubber latex continuously into a liquid slurry	
10		of the carbon black by feeding the liquid slurry as a continuous jet into the	
11		mixing zone; and	
12		B) simultaneously discharging rubber masterbatch globules from the discharge	
13		end of the coagulum reactor.	
1	30.	A continuous flow method of producing elastomer masterbatch comprising	

30. A continuous flow method of producing elastomer masterbatch comprising particulate filler selected from carbon black, silicon-treated carbon black, fumed silica, precipitated silica, and mixtures thereof finely dispersed in natural rubber, comprising:

preparing a particulate filler fluid by high energy dispersion of the particulate filler into aqueous liquid in a homogenizer; and



6	establishing a continuous, semi-confined flow of mixed natural rubber latex
7	and particulate filler in a coagulum reactor forming a generally tubular coagulum
8	zone extending with progressively increasing cross-sectional area from an entry end
9	to a discharge end by simultaneously
. 10	(i) feeding a liquid stream of the natural rubber latex at less than 10 feet
. 11	per second continuously to a mixing zone defined by a mix head in sealed
12	fluid communication with the entry end of the coagulum reactor, the mixing
13	zone extending coaxially with the coagulum zone, and
14	(ii) entraining the natural rubber latex continuously into the particulate
15	filler fluid by feeding the particulate filler fluid into the mixing zone toward
16	the entry end of the coagulum zone, through a feed tube substantially
17	coaxial with the coagulum zone, the particulate filler fluid exiting the feed
18	tube at a velocity of 200 to 500 feet per second;
19	simultaneously and continuously discharging from the discharge end of the
20	coagulum reactor masterbatch globules in which coagulation of the natural rubber latex by
21	the particulate filler is substantially complete; and
22	simultaneously and continuously drying and pelletizing masterbatch globules
23	discharged from the coagulum reactor in a series of dryers.
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1	31. Apparatus for producing elastomer masterbatch of particulate filler dispersed in
2	elastomer, comprising:
3	a coagulum reactor defining a mixing zone and an elongate coagulum zone
4	extending from the mixing zone to a discharge end;
5	latex feed means for feeding elastomer latex fluid continuously to the
6	mixing zone; and
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filler feed means for feeding particulate filler fluid as a continuous jet into the mixing zone to form a mixture with the elastomer latex fluid traveling from the mixing zone to the discharge end of the doagulum zone, with substantially complete coagulation of the elastomer latex prior to the discharge end.

The apparatus for producing elast/bmer masterbatch in accordance with claim 31 32. wherein the filler feed means is for feeding particulate filler fluid continuously to the mixing 2 zone through a nozzle at a velocity of 100 to 600 feet per second. 3

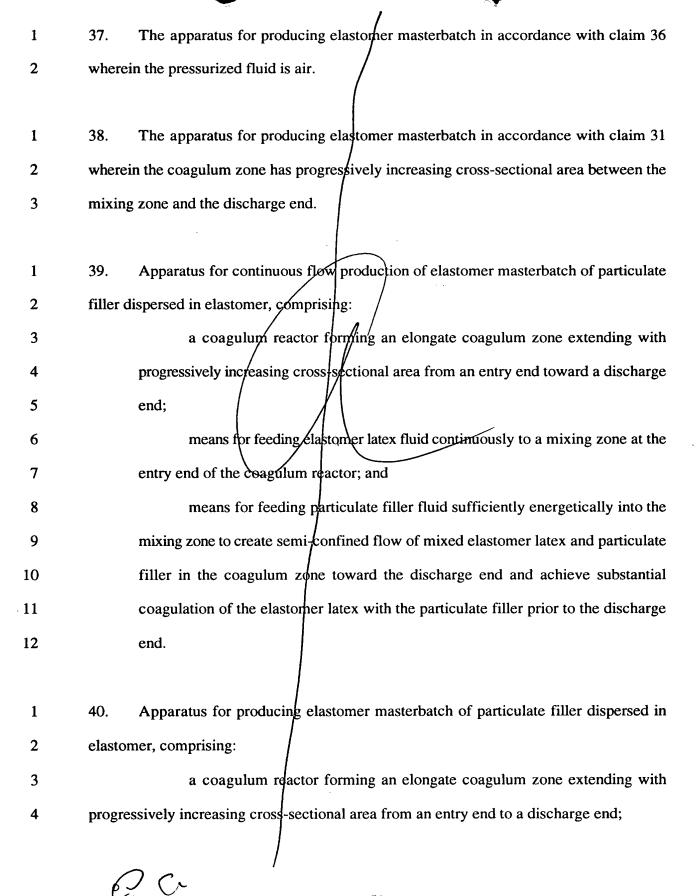
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- 1 33. The apparatus for producing clastomer masterbatch in accordance with claim 32 wherein the latex feed means is for feeding elastomer latex fluid continuously into the 2 3 mixing zone at a velocity less than 8 feet per second.
- The apparatus for producing elastomer masterbatch in accordance with claim 31 1 34. 2 wherein the filler feed means is for feeding particulate filler fluid continuously to the mixing zone under pressure of at least 75 pounds per square inch (guage). 3
- 1 35. The apparatus for producing elastomer masterbatch in accordance with claim 34 2 wherein the latex feed means is for feeding elastomer latex fluid continuously into the 3 mixing zone under pressure less than 12 pounds per square inch.
- 1 36. The apparatus for producing elastomer masterbatch in accordance with claim 31 2 further comprising auxiliary feed means for simultaneously feeding an additional stream of pressurized fluid to the mixing zone.



means for feeding elastomer latex fluid continuously to a mixing zone at the 5 6 entry end of the coagulum reactor; and means for feeding to the mixing zone a continuous jet of particulate filler 7 8 fluid effective to entrain elastomer latex fluid into an mixture with the particulate 9 filler fluid and to substantially completely coagulate the elastomer latex with the particulate filler prior to the mixture arriving at the discharge end. 10 1 41. The apparatus for continuous flow production of elastomer masterbatch in 2 accordance with claim 40 wherein the mixing zone is within a mix head and is substantially coaxial with the elongate coagulum zone. 3 The apparatus for continuous flow production of elastomer masterbatch in 1 42. accordance with claim 41 wherein the mix head is sealed to a coagulum zone extender. 2 1 43. The apparatus for continuous flow production of elastomer masterbatch in 2 accordance with claim 42 wherein the means for feeding a stream of particulate filler fluid comprises a first feed tube extending substantially coaxially within the mixing zone to a 3 nozzle open toward the coagulum zone. 4 The apparatus for continuous flow production of elastomer masterbatch in 1 44. 2 accordance with claim 43 wherein: the mix head forms a first feed channel substantially coaxial with the 3 coagulum zone extending from an entry port toward the coagulum zone; and 4 QC 6/97 52

the first feed tube extending coaxially within the first feed channel forms a fluid tight seal with the mix head at the entry port.

The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 44 wherein the first feed tube extends from the entry port to a nozzle

tip and wherein a constant diameter and within the first feed tube immediately upstream

1 46. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 44 wherein the means for feeding elastomer latex fluid comprises a second feed channel formed by the mix head at an angle of 30° to 90° to the first feed channel, extending to a junction with the mixing zone from a second entry port remote from the mixing zone.

of the nozzle tip has an axial dimension at least three times its diameter.

- 47. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 45 wherein the cross-sectional area of the coagulum zone immediately downstream of the mixing zone is more than twice the cross-sectional diameter of the first feed tube.
 - 48. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 47 wherein the cross-sectional area of the coagulum zone immediately downstream of the mixing zone is about 4 to 8 times the cross-sectional area of the first feed tube.

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- The apparatus for continuous flow production of elastomer masterbatch in 49. accordance with claim 45 wherein the/mix head forms at least one additional feed channel at an angle of 30° to 90° to the first/feed channel, extending to a junction with the mixing zone from an entry port remote from the mixing zone.
- 50. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 40 wherein at least a first portion of the coagulum zone extending from the entry end toward the discharge end has a circular cross-section and a central longitudinal axis, the circular cross-section increasing in size at an overall angle greater than zero degrees and less than 25 degrees to the central longitudinal axis.
- The apparatus for continuous flow production of elastomer masterbatch in 51. accordance with claim 40 wherein the cross-sectional area of the coagulum zone increases continuously toward the discharge end.
 - 52. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 50 wherein the cross-sectional area of the coagulum zone increases step-wise from the entry end toward the discharge end.
 - 53. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 51 wherein said first portion of the coagulum zone comprises:
 - a first section of substantially constant diameter D₁ extending a length L₁ from the entry end toward the discharge end, L_1 being at least three times D_1 , and

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multiple additional sections each having substantially constant cross	s-
sectional diameter, twice the cross-sectional area of an immediately preceding	ıg
section, and a length equal to at least three times its cross-sectional diameter.	

- 54. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 53 wherein the length L_1 of the first section is about 12 to 18 times its diameter D_1 .
- 55. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 54 wherein the coagulum zone extending from the entry end toward the discharge end has circular cross-section, increases in size step-wise toward the discharge end, and has
 - a first section beginning at the entry end having a substantially constant cross-sectional diameter D_1 equal to 5 to 8 times the cross-sectional diameter of the nozzle, a cross-sectional area A_1 , and a length L_1 which is 12 to 18 times D_1 ;
 - a second section extending toward the discharge end from a faired connection to the first section, having a substantially constant cross-sectional diameter D_2 , a cross-sectional area A_2 approximately two times A_1 , and a length L_2 approximately three to seven times D_2 ;
 - a third section extending toward the discharge end from a faired connection to the second section, having a substantially constant cross-sectional diameter D_3 , a cross-sectional area A_3 approximately two times A_2 , and a length L_3 approximately three to seven times D_3 ; and
 - a fourth section extending toward the discharge end from a faired connection to the third section, having a substantially constant cross-sectional diameter D_4 , a

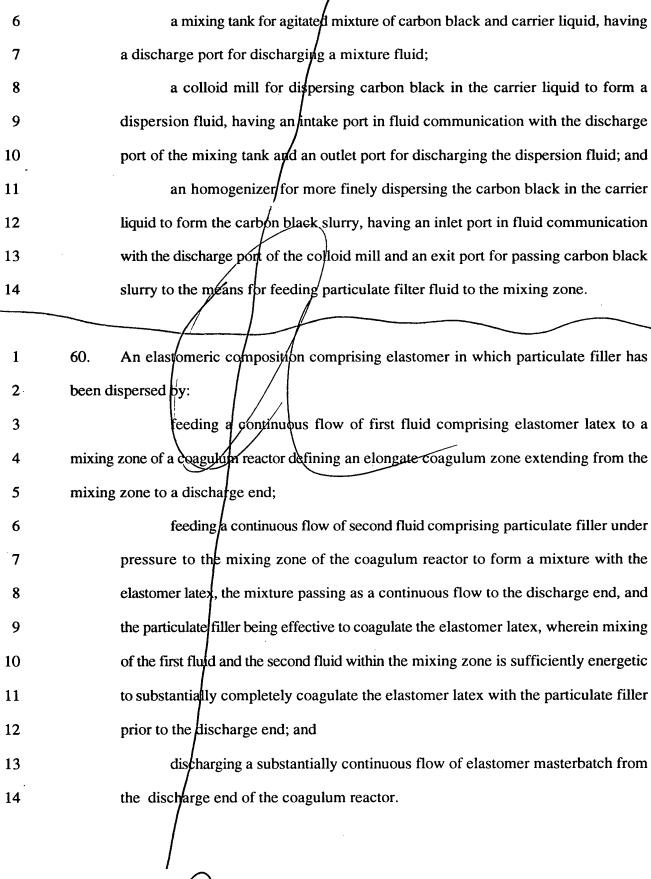
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cross-sectional area A4 approxin	ately two times A_3 , and a length L_4 approximately

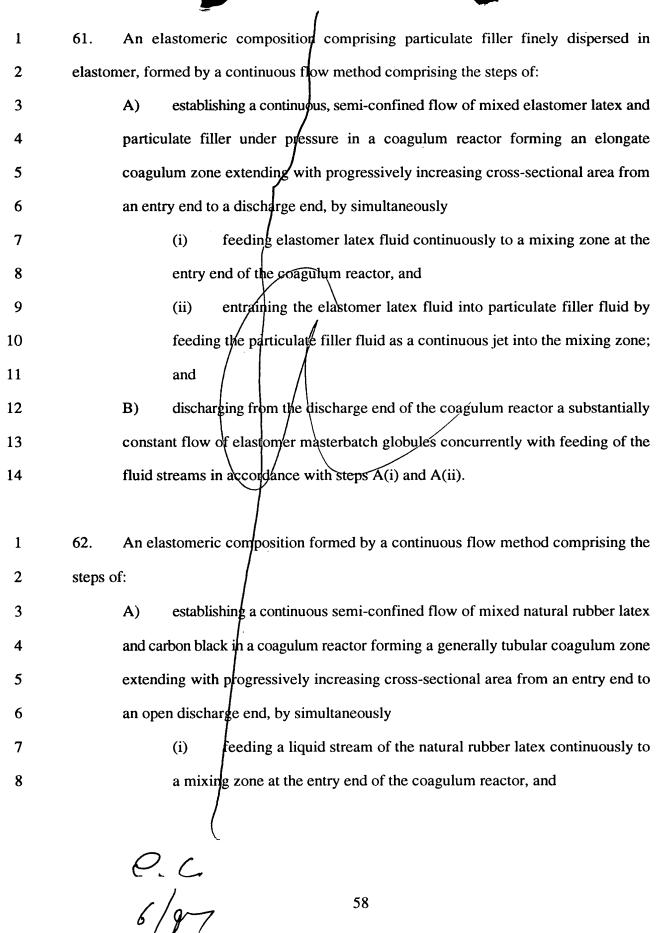
56. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 40 further comprising a diverter for receiving elastomer masterbatch from the discharge end of the coagulum zone and passing the elastomer masterbatch selectively to any of multiple receiving sites.

three to seven times D_4 .

- 57. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 56 wherein the diverter comprises a flexible conduit having one end attached to the discharge end of the coagulum reactor and a second end moveable to any of the multiple receiving sites.
 - 58. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 56 wherein the means for feeding particulate filler fluid comprises pumping means for developing said pressure to greater than 75 psig and the means for feeding elastomer latex fluid comprises a holding tank and feed line for developing less than 10 psig elastomer latex fluid pressure.
 - 59. The apparatus for continuous flow production of elastomer masterbatch in accordance with claim 40, wherein the particulate filler fluid is carbon black slurry comprising carbon black in a carrier liquid, further comprising carbon black slurry preparation means in fluid communication with the means for feeding particulate filler fluid to the mixing zone, comprising:

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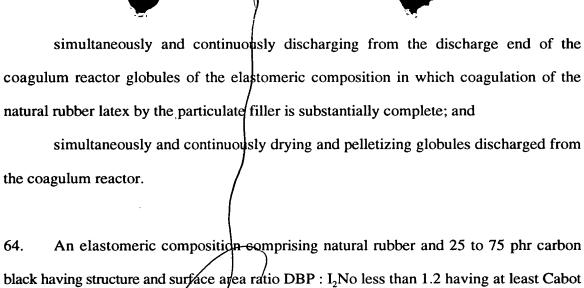




9	(ii) entraining the natural rubber latex continuously into a liquid slurr
10	of the carbon black by feeding the liquid slurry as a continuous jet into the
11	mixing zone; and
12	B) simultaneously discharging elastomer masterbatch globules from the
13	discharge end of the coagulum feactor.
•	
1	63. An elastomeric composition formed by a continuous flow method comprising th
2	following steps:
3	preparing a particulate filler fluid by high energy dispersion of th
4	particulate filler into aqueous liquid in a homogenizer; and
5	establishing a continuous, semi-confined flow of mixed natural rubber late
6	and particulate filler in a chagulum reactor forming a mixing zone and a generall
7	tubular coagulum zone extending with progressively increasing cross-sectional are
8	from the mixing zone to a discharge end by simultaneously
9	(i) feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding alliquid stream of the natural rubber latex at less than 10 feeding all rubber latex.
10	per second continuously to a mixing zone defined by a mix head in seale
11	fluid communication with a coagulum zone extender, the mixing zon
12	extending coakially with the coagulum zone, and
13	(ii) entraining the natural rubber latex continuously into the particulat
14	filler fluid by feeding the particulate filler fluid into the mixing zon
15	through a feed tube substantially coaxial with the coagulum zone, th
16	particulate filler fluid exiting the feed tube at a velocity of 200 to 500 fee
17	per second;

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- Dispersion Rating of at least A3 measured by ASTM D2663 method.
- An elastomeric composition comprising natural rubber and carbon black, wherein 65. the carbon black has structure and surface area ratio DBP: I2No less than 1.0 and the composition has macro-dispersion of the carbon black to a degree of at least Cabot Dispersion Rating A1 measured by ASTM D2663 method.
- Tire tread comprising clastomeric composition in accordance with any of claims 60 66. to 65.
- Cured elastomer / compound comprising the cured product of elastomeric 67. 1 2 composition in accordance with any of claims 60 to 65.

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